CUSTOMER NO.: 38107

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE HONORABLE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of Jurgen WEESE, *et al.*	)	Examiner: David RASHID
	)	Art Unit: 2624
Serial No.: 10/520,988	)	Confirmation: 9474
Filed: January 1, 2005	)	
For: **MOTION ARTIFACT CORRECTION OF TOMOGRAPHICAL IMAGES**	)	
Date of Last Office Action: November 8, 2007	)	
Attorney Docket No.: PHDE020167US/PKRZ201233	)	Cleveland, OH 44114 December 26, 2008

BRIEF ON APPEAL

CERTIFICATE OF ELECTRONIC TRANSMISSION

I certify that this **BRIEF ON APPEAL** and accompanying documents in connection with U.S. Serial No. 10/520,988 is being filed on the date indicated below by electronic transmission with the United States Patent and Trademark Office via the electronic filing system (EFS-Web).

December 29 2008
Date

Patricia A. Heim
Patricia A. Heim

I. STATEMENT OF REAL PARTY IN INTEREST (41.37(f))

The real party in interest for this appeal and the present application is Koninklijke Philips Electronics N.V.

II. STATEMENT OF RELATED CASES (41.37(g))

None

III. JURISDICTIONAL STATEMENT (41.37(h))

The Board has jurisdiction under 35 U.S.C. 134(a).

The Examiner mailed a final rejection on September 4, 2008, setting a three-month shortened statutory period for response.

The time for responding to the final rejection expired on December 4, 2008. Rule 134.

A notice of appeal was filed on October 28, 2008.

The time for filing an appeal brief is two months after the filing of a notice of appeal. Bd.R. 41.37(c). The time for filing an appeal brief expires on Monday, December 29, 2008 (December 28, 2008 being a Sunday).

The appeal brief is being filed on the date set forth on the Certificate of Transmission.

IV. TABLE OF CONTENTS (41.37(i))

Page

V. TABLE OF AUTHORITIES (41.37(j))

Not Applicable

VI. STATUS OF AMENDMENTS (41.37(l))

No Amendments were filed After Final.

VII. GROUNDS OF REJECTION TO BE REVIEWED (41.37(m))

Whether claims 1-5, 7, 10-16, 19, 20, 22-30, 32, and 33 are anticipated in the sense of 35 U.S.C. § 102 by Bani-Hashemi (US 5,690,106).

Whether claims 6 and 8 are unpatentable in the sense of 35 U.S.C. § 103 over Bani-Hashemi in view of Tom ("Motion Estimation of Skeletonized Angiographic Images Using Elastic Registration").

Whether claims 9, 17, 18, 21, and 31 are unpatentable in the sense of 35 U.S.C. § 103 over Bani-Hashemi in view of Levin (US 5,546,472).

VIII. STATEMENT OF FACTS (41.37(n))

1. Bani-Hashemi relates to digital subtraction angiography, particularly digital subtraction angiography in which a stack of 2D images are treated as volumes of data (Bani-Hashemi, col. 1, lines 7-12).

2. In digital subtraction angiography, a mask image of the area of interest is acquired before a contrast agent and a contrast image is collected using the same imaging modality under as identical conditions as possible after a contrast agent has been injected (Bani-Hashemi, col. 1, lines 14-31).

3. One could use the three-dimensional flexible registration technique of Van Tran in which corresponding points p_m^n in the contrast image and q_m^n in the mask image are identified, and a transform W^n describes the scaling, rotation, and translation needed to move point p_m^n and q_m^n into alignment (Bani-Hashemi, col. 4, line 66 – col. 5, line 29).

4. Bani-Hashemi generates the mask and contrast images using rotational angiography which causes additional misregistration problems unique to rotational angiography which the Van Tran transformation does not address (Bani-Hashemi, col. 1, lines 39-63; col. 3, lines 35-53; col. 4, lines 25-60).

5. Bani-Hashemi develops an adaptation of the Van Tran transformation which provides registration for the stack of 2D mask images and the stack of 2D contrast images which are acquired by rotational imaging (Bani-Hashemi, col. 6, lines 3-11).

6. Bani-Hashemi is concerned with the additional error when there is a slight angular offset $\delta\theta$ between the sampling points when generating the mask and contrast images (Bani-Hashemi, col. 2, lines 35-39; col. 4, lines 25-33).

7. The mask and contrast images are subtracted in digital subtraction angiography in order to leave nothing except the contrast agent filled blood vessels (Bani-Hashemi, col. 1, lines 22-24.

IX. ARGUMENT (41.37(o))

A. Claims 1, 4-7, 9, 10, and 12 Are Not Anticipated By Bani-Hashemi

1. The Bani-Hashemi Reference

Bani-Hashemi does not disclose or fairly suggest a motion model. Bani-Hashemi does not collect appropriate data from which one could generate a motion model.

Bani-Hashemi relates to digital subtraction angiography, particularly digital subtraction angiography in which a stack of 2D images are treated as volumes of data (Bani-Hashemi, col. 1, lines 7-12). In digital subtraction angiography, a mask image of the area of interest is acquired before a contrast agent and a contrast image is collected using the same imaging modality under as identical conditions as possible after a contrast agent has been injected (Bani-Hashemi, col. 1, lines 14-31). If the mask and contrast images are perfectly aligned, a difference image formed by subtracting them will be an image of the contrast agent, i.e., the patient's vasculature. For various reasons outlined in Bani-Hashemi, the images are not inherently perfectly aligned and must be registered.

One could use the three-dimensional flexible registration technique of Van Tran in which corresponding points p_m^n in the contrast image and q_m^n in the mask image are identified, and a transform W^n describes the scaling, rotation, and translation needed to move points p_m^n

q_m^n into alignment (Bani-Hashemi, col. 4, line 66 – col. 5, line 29). However, Bani-Hashemi is generating the mask and contrast images using rotational angiography which causes additional misregistration problems unique to rotational angiography which the Van Tran transformation does not address (Bani-Hashemi, col. 1, lines 39-63; col. 3, lines 35-53; col. 4, lines 25-60). Bani-Hashemi develops an adaptation of the Van Tran transformation which provides registration for the stack of 2D mask images and the stack of 2D contrast images which are acquired by rotational imaging (Bani-Hashemi, col. 6, lines 3-11).

Rotational imaging is technique that is well-known in the art and is not described in detail in Bani-Hashemi. Consider an x-ray source and an x-ray detector which are disposed equi-distant from a plane. If the x-ray source and x-ray detector are moved back and forth parallel to the plane, but in opposite directions, the x-ray beam will pivot about a point on the plane. The data sampled during this movement will include a large number of samplings for the pivot point and samplings of all of the other stuff that surrounds it. One can expand this concept to a plurality of x-ray beams and detector elements such that the data sampled by each detector element represents many samplings of a corresponding point on the plane plus samplings of all of the other stuff. Assuming "all of the other stuff" is the same for each point, subtracting the other stuff from the collected data gives that data value for each point of the plane. This same effect

can be achieved when the x-ray source and detector are mounted on a C-arm which is rotated over 30-40°.

Now consider another plane above or below the first plane. The x-ray beams will not rock about points in this plane, since it is off-center. However, knowing the geometry of the plane relative to the x-ray source and the detector at each sampling, it only takes a little geometry to tell which beam is passing through each point in the second plane each time the data is sampled. In this manner, with a little mathematical manipulation, a stack of 2D images are generated.

Conventionally, the C-arm is rotated the 30-40° to generate a plurality of projections (e.g., every 2°) which are reconstructed into a stack of 2D mask images which function as a 3D mask image (collectively, "the mask image"). The mask image is blurred or artifacted by all patient motion occurring during data collection. The C-arm is stopped while the contrast agent is injected. After a short delay to allow the contrast agent to flow into the examination volume, the C-arm is rotated in the opposite direction and the data reconstructed to generate a stack of 2D contrast images (collectively, "the contrast image"). The mask image is again artifacted by all patient motion occurring during the contrast data collection. If the data is sampled at the exact same points around the arc. The mask and the contrast images align and the Van Tran algorithm would work fine. Bani-Hashemi is concerned with the

additional error when there is a slight angular offset $\delta\theta$ between the sampling points when one is generating the mask and contrast data (Bani-Hashemi, col. 2, lines 35-39; col. 4, lines 25-33).

2. Claim 1 is Not Anticipated By Bani-Hashemi

Claim 1 calls for acquiring first modality image data and reconstructing the first modality data into a motion artifacted first modality image (claim 1, lines 2-4). Bani-Hashemi generates a mask image which is likely artifacted using a first modality, particularly a C-arm x-ray system.

Claim 1 goes on to call for acquiring second modality image data and reconstructing the second modality data into second modality images which represent the object in respective states of motion with as few motion artifacts as possible. The contrast image of Bani-Hashemi is not acquired with a second modality. Rather, it is acquired with the self-same C-arm x-ray system as the mask image. Further, the contrast image of Bani-Hashemi does not represent the object in respective state<u>s</u> of motion. Rather, the Bani-Hashemi contrast image is as artifacted by patient motion during the data acquisition as the mask image. The contrast image does not depict respective states of motion. Having image<u>s</u> in respective state<u>s</u> of motion is important for developing a motion model. If there is only a single image with a second modality,

then one would have only a single data point which mathematically is not enough information from which to develop a mathematical model of motion.

Moreover, claim 1 calls for the second modality images to represent the object in the respective states of motion with as few motion artifacts as possible. That is, the first modality image was acquired as the object moves over a range of motion; whereas, claim 1 calls for the second modality image to be acquired in respective states of the motion. This causes the first modality image to be motion artifacted and each of the second modality images to represent the object with fewer motion artifacts. In Bani-Hashemi, the mask and contrast image data are collected over the same relatively long acquisition time and have the same degree of motion artifacting.

Claim 1 further calls for determining a motion model which characterizes states of motion assumed by the object while moving through the states of motion from the second modality images (claim 1, lines 8-10). The transform W^n is not a motion model. Rather, the transform W^n is determined by locating corresponding points in the mask and contrast images and determining the transform W^n therebetween.

Moreover, W^n does not characterize states of motion assumed by the object while moving through the states of motion. Even if the imaged region of the patient in Bani-Hashemi is undergoing movement, e.g.,

respiratory movement, the transform W^n does not characterize the various states of respiratory motion which the patient assumes while moving through the respiratory states. In Bani-Hashemi, the transform W^n merely describes the transform between the points $p_m{}^n$ and $q_m{}^n$ without even knowing or determining if such points moved, much less determining a model which characterizes respiratory or other states of motion assumed by the patient while moving through the states of breathing or other motion.

Claim 1 further calls for forming an intermediate image of the object from the motion model and the second modality images, which intermediate image represents the object as if it had moved during the acquiring of the second modality image data over the range of motion over which the object had moved as the first modality image data was acquired (claim 1, lines 11-14). In Bani-Hashemi, the mask and contrast images both already represent the patient as if it had moved over a range of motion. Operating on the mask image with the transform W^n does not create a represention of the object as if it had moved over the range of motion which the object moved during the acquiring of the mask (or contrast) imaging data. Again, the mask and contrast images of Bani-Hashemi are acquired with the same imaging modality.

Finally, claim 1 calls for a combination image formed from an intermediate image which was derived from the second modality image<u>s</u>

and the first modality image (claim 1, lines 15-16). By contrast, Bani-Hashemi combines images which came not only from the same modality, but from the self-same piece of diagnostic imaging equipment.

Accordingly, it is submitted that claim 1 and claims 4-7, 9, 10, and 12 dependent therefrom are not anticipated by or rendered obvious by Bani-Hashemi.

3. **Claim 4 is Not Anticipated by Bani-Hashemi**

Claim 4 calls for determining a respective motion vector field for parts of the object. The transform W^n is not a motion vector field. It is a simple transform denoting the difference in location between points p_m^n and q_m^n. Accordingly, it is submitted that claim 4 is not anticipated by Bani-Hashemi.

4. **Claim 5 is Not Anticipated by Bani-Hashemi**

Claim 5 calls for forming other images of other states of motion of the object from the second modality image data. Bani-Hashemi generates one contrast image. It does not form a contrast image of other state<u>s</u> of motion.

Claim 5 further calls for weighting and subsequently superimposing other images with the second modality images reconstructed in claim 1 in conformity with a frequency at which each of

the other states of motion are assumed by an object while moving through the range of motion while the first modality image data was acquired. In Bani-Hashemi, the transform W^n does not weight images, does not superimposed other second modality or contrast images, does not superimpose images in conformity with a frequency, does not superimpose second modality images at a frequency at which each of the states of motion were assumed, and does not superimpose second modality or contrast images in conformity with a frequency at which states of motion were assumed by the patient during the acquisition of the mask imaging data. Again, the mask and contrast images were acquired with the same imaging modality, not different imaging modalities.

Accordingly, it is submitted that claim 5 is not anticipated by Bani-Hashemi.

5. Claim 6 is Patentable Over the References of Record

Claim 6 calls for elastically registering the intermediate image and the first modality image. Although Bani-Hashemi is directed to a flexible registration process, Bani-Hashemi does not twice register the mask and contrast images. That is, Bani-Hashemi flexibly transforms the mask image to generate a transformed mask image, but does not then

perform a second elastic transformation on the transformed mask image before it is combined with the contrast image.

Tom discloses an elastic transform, but does not address or cure the above-noted shortcoming of Bani-Hashemi.

Accordingly, it is submitted that claim 6 is neither anticipated by nor obvious over Bani-Hashemi or Bani-Hashemi in combination with Tom.

6. **Claim 7 is Not Anticipated by Bani-Hashemi**

Claim 7 calls for focusing the combination image. Bani-Hashemi does not focus the combination image. The Examiner asserts that subtracting the mask and contrast images is "focusing". First, it is determining a difference, not focusing. Second, the subtracting is performed on the mask and contrast images, not the difference image which the Examiner previously defined as the combination image. The subtracting step is not performed on the difference image. Accordingly, Bani-Hashemi neither shows focusing, nor performing any analogous operation on the difference image.

Accordingly, it is submitted that claim 7 is not anticipated by Bani-Hashemi.

7. Claim 9 is Patentable Over the References of Record

Claim 9 calls for the first modality to be one of PET or SPECT, and the second modality to be one of CT or MR. Levin shows that CT, PET, and SPECT are known imaging technologies. However, just because other imaging technologies are known does not provide reason to use different imaging technologies for the mask and contrast images. Changing imaging modalities between the mask and the contrast images would create different types of background which would not subtract completely. For example, PET imaging images the distribution of a radioisotope pharmaceutical injected into the subject; CT images x-ray attenuation properties, MR measures the presence of a resonating dipole, typically hydrogen. Thus, each of these imaging modalities produces images with different characteristics. Because subtracting such images with different characteristics would not remove the background material between the mask and contrast images in the digital subtraction angiography technique described in Bani-Hashemi, it is submitted that Bani-Hashemi teaches against mixing imaging modalities.

8. **Conclusion**

For the reasons set forth above, it is submitted that claim 1 and claims 4-6, 9, 10, and 12 dependent therefrom are not anticipated by and distinguish patentably over the references of record.

B. **Claims 2, 8, 13, 15, and 17 Are Not Anticipated By and Distinguish Patentably Over Bani-Hashemi**

1. **Claim 2 is Not Anticipated by Bani-Hashemi**

Claim 2 for a method of enhancing a first image. In Bani-Hashemi, the first image is a mask image.

Claim 2 further calls for acquiring further images that represent the object in respective states of motion with as few motion artifacts as possible. Bani-Hashemi acquires a contrast image corresponding to the mask image, but does not acquire further image<u>s</u> and the contrast image is not used to enhance the first or mask image. The contrast image of Bani-Hashemi is not image<u>s</u> that represent the object in respective state<u>s</u> of motion. Rather, the contrast image of Bani-Hashemi is a single 3D image or stack of 2D images which correspond as nearly as possible to the single 3D mask image or stack of 2D mask images.

Claim 2 further calls for determining a motion model that characterizes states of motion assumed by the object from the further images. Bani-Hashemi does not determine a motion model from the

contrast image. In order to develop a mathematical model of motion, one would need a plurality of data points. In claim 2, the plurality of data points come from the further images which represent the object in respective states of motion. The contrast image of Bani-Hashemi may be motion artifacted, but it does not represent the patient in respective states of motion. One cannot determine a model of any motion which the patent may be undergoing by looking at the contrast image. The transform W^n is not a motion model and is not determined from a plurality of images that respresent the object in respective states of motion. Rather, the transform W^n is determined by determining the difference in position $p_m{}^n$ and $q_m{}^n$ of common points in the mask and contrast images. It is not determined from further images or from the contrast image taken alone. The transform W^n does not model motion and is not a motion model.

Claim 2 further calls for focusing the first image by means of the motion model. The transform W^n of Bani-Hashemi is not a motion model and was not determined from the contrast image. Nor does the transform W^n focus the mask image. Rather, the transform W^n is used to spatially transform one of the mask image into registration with the contrast image. The performing of such translating, rotating, and scaling is a registration process, not a focusing process.

Previously, in conjunction with claim 7, the Examiner asserted that the focusing was achieved by the subtraction step of Bani-Hashemi.

Claim 2 calls for the focusing to be performed by the motion model. Operating on the mask image with the transform W^n does not focus the mask image, it merely transforms it to another coordinate system.

Accordingly, it is submitted that claim 2, and claims 8, 13, 15, and 17 dependent therefrom are not anticipated by and are patentable over the references of record.

2. Claim 8 is Patentable Over the References of Record

Claim 8 calls for registering the focused image and at least one further image. Operating at one of the mask and contrast images of Bani-Hashemi with the transform W^n in the registration process spatially transforms the image – it does not focus the image. Bani-Hashemi provides no motivation to operate on the spatially transformed mask image with the transform W^n a second time. Indeed, such an operation would unregister the images and make them as unregistered as they were initially. Replacing the flexible transform of Bani-Hashemi with the elastic transform of Tom does not cure this shortcoming, nor does it provide any reason why one would operate on the mask image with both flexible and elastic transforms which would move the images into registration and back out of registration.

Further, claim 8 calls for forming a combination image by combining the focused first image and the at least one further image. If one were to operate on the mask image of Bani-Hashemi with transform W^n or the transform of Tom to "focus" it and again to "register" it, and then combine the images, it is submitted that such images would be misregistered. Bani-Hashemi would be rendered inoperative for its intended purpose.

Accordingly, it is submitted that claim 8 distinguishes patentably and unobviously over the references of record.

3. **Claim 14 is Not Anticipated by Bani-Hashemi**

The spatial transform W^n of Bani-Hashemi is not a motion model nor is it a motion vector field, nor is it a motion vector field for parts of the object.

Accordingly, it is submitted that claim 14 is not anticipated by Bani-Hashemi.

4. **Claim 15 is Not Anticipated by Bani-Hashemi**

Claim 15 calls for forming additional images. Bani-Hashemi only forms one contrast image and one mask image (actually the stack of 2D images which taken together form a single volume image). There is no suggestion of forming additional mask or contrast images. Moreover,

claim 15 calls for the additional images to be of other states of motion. Bani-Hashemi does not suggest generating additional mask, contrast, or other images of other states of motion.

Claim 15 calls for weighting and superimposing the other images. Bani-Hashemi subtracts the mask and contrast images but discloses no imaging weighting.

Claim 15 calls for this weighting and superimposing to be done in conformity with a frequency at which the other states of motion are assumed by the object moving over the range of motion over which the first modality image data was acquired. Bani-Hashemi makes no suggestion of weighting and superimposing images with a frequency which conforms to states of motion assumed by an object. Accordingly, it is submitted that claim 15 is not anticipated by Bani-Hashemi.

5. **Claim 17 is Not Anticipated by Bani-Hashemi**

Claim 17 calls for the first image to be a PET or SPECT image and the second image to be a CT or MR image. Although Levin discloses that CT, PET, and SPECT are known imaging modalities, Levin provides no motivation to generate the mask and contrast images of Bani-Hashemi using different imaging modalities. Indeed, because Bani-Hashemi wants to subtract the mask and different images to remove the background, it is submitted that if one were to use two different imaging modalities, one

would expect that the background would not subtract and that it would create artifacts. Accordingly, it is submitted that Bani-Hashemi teaches against the combination of claim 17.

Accordingly, it is submitted that claim 17 distinguishes patentably and unobviously over the references of record.

6. **Conclusion**

For the reasons set forth above, it is submitted that claims 8, 13, 15, and 17 dependent therefrom are not anticipated by and distinguish patentably over the references of record.

C. **Claims 3, 14, 16 and 18 Are Not Anticipated by and Distinguish Patentably Over the References of Record**

1. **Claim 3 is Not Anticipated By Bani-Hashemi**

Claim 3 calls for a method of enhancing information content of a first image of a moving object to be reconstructed from projections acquired as the object moves over a plurality of states of motion. The mask image of Bani-Hashemi does have motion artifacts.

Claim 3 further calls for acquiring further images that represent the object in at least two states of motion. In Bani-Hashemi, the contrast image was acquired over the same duration as the mask image. Bani-Hashemi has no images depicting different motion states.

Claim 3 calls for determining a motion model from the plurality of further images. Bani-Hashemi does not generate a plurality of contrast images in different motion states nor generate a motion model from such plurality of images. The transform W^n of Bani-Hashemi which the Examiner asserts is a motion model is not determined from a plurality of contrast images. The transform W^n represents a spatial transformation between a point p_m^n in the contrast image and a point q_m^n in the mask image. It does not model motion among a plurality of states of motion assumed by the object while the mask data was acquired.

Further, claim 3 calls for forming an intermediate image from the motion model and the further images, which intermediate image represents one or more states of motion assumed by the object while the first image data was acquired. Operating on the mask image of Bani-Hashemi with the spatial transform W^n is not forming an intermediate image from a motion model and further images and it does not represent one or more states of motion assumed by the patient as the mask data was acquired.

Claim 3 further calls for reconstructing the first image from the projections and the at least one intermediate image. In Bani-Hashemi, the mask (first) image is reconstructed from the mask projection data. The mask image transformed with the transform W^n is not used in the reconstruction of the mask image.

Accordingly, it is submitted that claim 3 and claims 11, 14, 16 and 18 dependent therefrom are not anticipated by Bani-Hashemi or rendered unpatentable by Bani-Hashemi in combination with other references.

2. Claim 14 is Not Anticipated by Bani-Hashemi

Claim 14 calls for determining a respective motion vector field for parts of the object. As set forth above in Section A3, Bani-Hashemi does not determine a motion vector field. Accordingly, it is submitted that Bani-Hashemi does not anticipate claim 14.

3. Claim 16 is Not Anticipated by Bani-Hashemi

Claim 16 calls for forming additional images and weighting and superimposing the other images and the second modality images in conformance with a frequency at which states of motion were assumed, analogous to claim 5. For the reasons set forth in Section A4 above, it is submitted that the limitations of claim 16 are not anticipated by Bani-Hashemi.

4. Claim 18 is Not Unpatentable Over Bani-Hashemi and Levin

Claim 18 calls for the first image and the further images to be generated by different imaging modalities, particularly PET or SPECT and CT. As discussed in greater detail above, although Levin discloses that PET, SPECT, and CT are known imaging modalities, neither Levin nor Bani-Hashemi teach or fairly suggest generating the mask and contrast images for digital subtraction angiography using different imaging modalities. Accordingly, it is submitted that claim 18 is patentable over the references of record.

5. Conclusion

For the reasons set forth above, it is submitted that claims 3, 14, 16 and 18 are not anticipated by and distinguish patentably over the references of record.

D. Claims 19-23, 25-27, and 33 Are Not Anticipated by and Distinguish Patentably Over the References of Record

1. Claim 19 is Not Anticipated by Bani-Hashemi

Claim 19 calls for acquiring a first sequence of image data using a first imaging modality data acquisition system and a second sequence of image data using a second imaging modality data acquisition system. In

Bani-Hashemi, the same C-arm x-ray system is used to acquire the mask and contrast image data sets.

Claim 19 calls for determining a motion model related to a periodic motion of an object based on the second sequence of image data. The transform W^n of Bani-Hashemi is not a motion model. Moreover, the transform W^n of Bani-Hashemi is not determined based on a sequence of contrast image data. W^n is a spatial transform and does not model motion and is not a motion model.

Claim 19 further calls for generating a first modality image data set in a selected motion state from the first sequence of image data using the motion model. Bani-Hashemi does not generate an image data set of either mask or contrast images, each in a selected motion state. Rather, Bani-Hashemi uses the transform W^n to register the mask and contrast images spatially. Moreover, the transform W^n of Bani-Hashemi and one of the mask and image data sets is not described as being used to generate a data set of the mask or contrast images in a selected motion state.

Accordingly, it is submitted that claim 19 and claims 20-23, 25-27 and 34 dependent therefrom are not anticipated by and distinguish patentably over the references of record.

2. Claim 20 is Not Anticipated By Bani-Hashemi

Claim 20 calls for generating a combined image data set in the selected motion state from the first modality image data set and a second modality image data set in the selected motion state. By contrast, Bani-Hashemi merely subtracts the mask and contrast images, one of which has been spatially transformed by the W^n into registration. Accordingly, it is submitted that claim 20 is not anticipated by Bani-Hashemi.

3. Claim 21 is Not Anticipated By the References of Record

Claim 21 calls for the first imaging modality data acquisition system to be PET or SPECT. Levin merely shows that PET and SPECT are known imaging modalities, but provides no motivation to substitute PET or SPECT data acquisition for the C-arm radiation data acquisition system of Bani-Hashemi to collect the mask image data. Accordingly, it is submitted that claim 21 distinguishes patentably and unobviously over the references of record.

4. Claim 23 is Not Anticipated By Bani-Hashemi

Claim 23 calls for registering coordinate systems of the first and second imaging modality data acquisition systems. Bani-Hashemi does

register the coordinate systems of the mask and contrast images using the transform W^n. However, Bani-Hashemi uses the transform W^n once to perform the registration and does not use it a prior time to generate a motion model. Accordingly, it is submitted that claim 23 is not anticipated by Bani-Hashemi and emphasizes that its parent claim 19 is not anticipated by Bani-Hashemi.

5. Claim 25 is Not Anticipated By Bani-Hashemi

Claim 25 calls for sensing motion of the object during acquisition of at least the second sequence of imaging data. Bani-Hashemi does not sense motion of the object. The transform W^n of Bani-Hashemi does not use *a priori* knowledge regarding how the patient has moved. Rather, the transform W^n is determined by finding corresponding points $p_m{}^n$ and $q_m{}^n$ in the contrast and mask images, without any knowledge of how or if the patient may have moved. Because the transform W^n of Bani-Hashemi does not use any knowledge of patient motion to function satisfactorily, it is submitted that there would no motivation or reason to modify Bani-Hashemi to add a motion sensor. Accordingly, it is submitted that claim 25 is not anticipated by Bani-Hashemi.

6. Claim 26 is Not Anticipated By Bani-Hashemi

Bani-Hashemi not only does not sense motion, Bani-Hashemi does not sense cyclic motion in which the object cyclically assumes a plurality of motion states. The images of Bani-Hashemi may be artifacted due to cyclic motion. However, Bani-Hashemi determines the transform W^n without any knowledge of such motion, or if such motion even occurred. Bani-Hashemi neither senses nor provides any motivation to sense cyclic motion. Accordingly, it is submitted that claim 26 is not anticipated by Bani-Hashemi.

7. Claim 27 is Not Anticipated By Bani-Hashemi

Claim 27 calls for the motion model to include a motion vector field which indicates movement between at least two motion states. The spatial transform W^n of Bani-Hashemi is not a motion vector field, nor does it indicate movement between two motion states. Rather, the spatial transform W^n indicates the spatial transform between each of points p_m^n and q_m^n in the contrast and mask images. Accordingly, it is submitted that claim 27 is not anticipated by Bani-Hashemi.

8. Claim 34 is Not Anticipated by Bani-Hashemi

Claim 34 calls for the sensed motion to be periodic motion. Again, Bani-Hashemi does not sense motion. The transform W^n is

developed without any *a priori* knowledge of patient motion. Accordingly, it is submitted that claim 34 is not anticipated by Bani-Hashemi.

9. Conclusion

For the reasons set forth above, it is submitted that claim 19 and claims 20-23, 25-27, and 34 dependent therefrom are not anticipated by and distinguish patentably over the references of record.

E. Claims 28-31 Are Patentable Over the References of Record.

1. Claim 28 is Not Anticipated By Bani-Hashemi

Claim 28 calls for a motion sensor for sensing object motion. The Examiner asserts that the processor and display 14 of Bani-Hashemi is a motion sensor which senses motion of the object or patient 40. To the contrary, the processor and display 14 of Bani-Hashemi performs the described processing and displays the subtraction angiographic image. It is not a motion sensor.

Claim 28 further calls for a processor which determines a motion model from the sensed motion and the second modality sequence of image data. The processor 14 of Bani-Hashemi determines a spatial transform between corresponding points p_m^n and q_m^n in the contrast and

mask images to bring the two images into alignment, i.e., "register" the two images. Bani-Hashemi performs this registration without any knowledge whether or how the patient moved. Rather, the transform is developed based on comparing the location of like structures in the mask and contrast images. The spatial transform W^n of Bani-Hashemi is not a motion model of sensed motion. Accordingly, it is submitted that claim 28 and claims 29-31 dependent therefrom are not anticipated by and distinguish patentably over the references of record.

2. **Claim 29 is Not Anticipated By Bani-Hashemi**

Claim 29 calls for the motion model to characterize motion states assumed by the object while moving among a plurality of motion states. The spatial transform W^n of Bani-Hashemi is a static, spatial transform. It does not characterize motion, nor does it characterize motion states, nor does it characterize motion states assumed by an object while moving among a plurality of motion states. Accordingly, it is submitted that claim 29 is not anticipated by Bani-Hashemi.

3. **Claim 30 is Not Anticipated By Bani-Hashemi**

Claim 30 calls for operating mathematically with the motion model to transform the first imaging modality data into a selected motion state. Again, the spatial transform W^n of Bani-Hashemi is not a motion

model; rather, it is used to register the mask and contrast images. There is no disclosure in Bani-Hashemi of using the spatial transform W^n to transform imaging data of either the mask or contrast image into a selected motion state.

The Examiner asserts that θ_1 in Figure 3 is a motion state. By distinction, θ represents an angular orientation of the C-arm (Bani-Hashemi, col. 4, lines 25-32). Accordingly, it is submitted that claim 30 is not anticipated by Bani-Hashemi.

Claim 30 calls for operating mathematically with the motion model to transform the first imaging modality image data to a selected motion state. Bani-Hashemi does not disclose or suggest transforming data to a selectable motion state. Accordingly, it is submitted that Bani-Hashemi does not anticipate claim 30.

4. Claim 31 is Distinguishes Patentably and Unobviously Over the References of Record

Claim 31 calls for the first imaging modality data acquisition system to be a PET system and the second to be a CT system. Although Levin does disclose that PET and CT systems are known, neither Bani-Hashemi nor Levin provide any teaching or suggestion that one should use different imaging modalities to generate the mask and contrast image data in the Bani-Hashemi system. Indeed, because the two images

are subtracted in attempt to remove all but the contrast agent contribution in Bani-Hashemi, it is submitted that collecting the mask and contrast data with two different imaging modalities would defeat the intended purpose of Bani-Hashemi. Accordingly, it is submitted that claim 31 is patentable over the references of record.

F. Claims 32 and 33 Are Not Anticipated By Bani-Hashemi

1. Claim 32 is Not Anticipated By Bani-Hashemi

Claim 32 calls for generating a plurality of images using a second imaging modality and from such plurality of second modality images and from sensed motion of the object, generating a motion model. First, Bani-Hashemi does not sense motion of the patient 40. Bani-Hashemi corrects for any patient motion which may have occurred without knowing whether or how the patient has moved. Bani-Hashemi does not sense motion of the imaged patient.

Moreover, Bani-Hashemi does not generate a motion model. The spatial transform W^n of Bani-Hashemi is not a motion model. It is a spatial transform which brings corresponding mask and contrast image elements into registration for proper subtraction.

Claim 32 further calls for operating on the first modality image data with the motion model to create a first modality image in a selected

motion state. In Bani-Hashemi, the spatial transform W^n is used to find the corresponding mask element for each element of the contrast image for use in a subtraction process. Bani-Hashemi does not generate a mask image in a selected motion state.

Accordingly, it is submitted that claim 32 and claim 33 dependent therefrom are not anticipated by Bani-Hashemi.

G. CONCLUSION

For all of the reasons discussed above, it is respectfully submitted that Bani-Hashemi relates to a registration process (note, for example the registration process R2 of Figure 1 of the present application) and does not disclose or fairly suggest the generation of a motion model (note motion model M2 of Figure 1 of the present application) through which images can be generated in a selected motion state. For the reasons set forth in the preceding sections, it is submitted that claims 1-23 and 25-34 are not anticipated by and distinguish patentably over the references of record. An early reversal of all rejections of all claims is requested.

Respectfully submitted,

Thomas E. Kocovsky, Jr.
Registration No. 28,383

FAY SHARPE LLP
The Halle Building, 5th Floor
1228 Euclid Avenue
Cleveland, OH 44115-1843
Telephone: (216) 363-9000 (main)
Telephone: (216) 363-9122 (direct)
Facsimile: (216) 363-9001
E-Mail: tkocovsky@faysharpe.com

APPENDIX

X. CLAIMS SECTION (41.37(p))

1. (Rejected) A method comprising:

acquiring first modality image data while an imaged object moves over a range of motion and reconstructing the first modality image data into a motion artifacted first modality image;

acquiring second modality image data and reconstructing the second modality image data into second modality images which represent the object in respective states of motion with as few motion artifacts as possible;

from the second modality images, determining a motion model which characterizes states of motion assumed by the object while moving through the states of motion;

forming an intermediate image of the object from the motion model and the second modality images, the intermediate image representing the object as if it had moved during the acquiring of the second modality image data over the range of motion over which the object moved as the first modality imaging data was acquired;

forming a combination image from the intermediate image and the first modality image.

2. (Rejected) A method of enhancing a first image of a moving object, the first image containing motion artifacts, the method including:

a. acquiring further images that represent the object in respective states of motion with as few motion artifacts as possible;

b. from the further images, determining a motion model that characterizes the states of motion assumed by the object;

c. focusing the first image by means of the motion model.

3. (Rejected) A method of enhancing information contents of a first image of a moving object, to be reconstructed from projections acquired as the object moves over a plurality of states of motion and containing motion artifacts, which method includes:

a. acquiring further images that represent the object in at least two of the states of motion with as few motion artifacts as possible;

b. from the further images, determining a motion model that characterizes the states of motion assumed by the object while the projections are acquired;

c. forming at least one intermediate image of the object from the motion model and the further images, the at least one intermediate image representing one or more of the states of motion assumed by the object while the projections are acquired;

d. reconstructing the first image from the projections of the object and the at least one intermediate image.

4. (Rejected) The method as claimed in claim 1, wherein determining the motion model includes:

determining a respective motion vector field for parts of the object.

5. (Rejected) The method as claimed in claim 1, wherein forming the intermediate image includes:

forming other images of other states of motion of the object from the second modality image data;

weighting and subsequently superimposing the other images and the second modality images in conformity with a frequency at which each of the other states of motion were assumed by the object while moving over the range of motion while the first modality image data was acquired.

6. (Rejected) The method as claimed in claim 1, further including:

elastically registering the intermediate image and the first modality image prior to the formation of the combination image.

7. (Rejected) The method as claimed in claim 1, further including:

focusing the combination image.

8. (Rejected) The method as claimed in claim 2, further including:

registering the focused image and at least one of the further images; and

forming a combination image from the focused first image and the at least one of the further images.

9. (Rejected) The method as claimed in claim 1, wherein the first modality image is one of a positron emission tomography (PET) image or a single positron emission computed tomography (SPECT) image and the second modality images are one of computed tomography (CT) images and magnetic resonance (MR) images.

10. (Rejected) An image processing system which includes a data processing unit for carrying out the method as claimed in claim 1.

11. (Rejected) A medical examination apparatus, the apparatus including:

a device for forming images or projections by means of a first imaging method;

a second device for forming images or projections by means of a second imaging method;

an image processing system that includes a data processing unit for carrying out the method as claimed in claim 1.

12. (Rejected) A computer readable medium containing instructions for controlling a data processing unit in such a manner that the data processing unit can carry out the method as claimed in claim 1.

13. (Rejected) The method as claimed in claim 2, wherein determining the motion model includes:

determining a respective motion vector field for parts of the object.

14. (Rejected) The method as claimed in claim 3, wherein determining the motion model includes:

determining a respective motion vector field for parts of the object.

15. (Rejected) The method as claimed in claim 2, further including:

forming additional images of others of the states of motion of the object from the further images and the motion model;

weighting and subsequently superimposing the other images and the second modality images in conformity with a frequency at which each of the other states of motion were assumed by the object while moving over the range of motion over which the first modality image data was acquired.

16. (Rejected) The method as claimed in claim 3, further including:

forming additional images of others of the states of motion of the object from the further images and the motion model;

weighting and subsequently superimposing the other images and the second modality images in conformity with a frequency at which each of the other states of motion were assumed by the object while moving over the range of motion at which the first modality image data was acquired.

17. (Rejected) The method as claimed in claim 2 wherein the first image is a positron emission tomography (PET) image or a single positron emission computed tomography (SPECT) image and the further images are one of computed tomography (CT) images and magnetic resonance (MR) images.

18. (Rejected) The method as claimed in claim 3 wherein the first image is a positron emission tomography (PET) image or a single positron emission computed tomography (SPECT) image and the further images are one of computed tomography (CT) images and magnetic resonance (MR) images.

19. (Rejected) A method of motion compensation comprising:

acquiring a first sequence of image data of a moving object by a first imaging modality data acquisition system;

acquiring a second sequence of image data of the moving object by a second imaging modality data acquisition system;

determining a motion model related to periodic motion of the object based on the second sequence of image data;

using the determined motion model, generating from the first sequence of image data a first modality image data set in a selected motion state.

20. (Rejected) The method as claimed in claim 19, further including:

generating a combined image data set in the selected motion state from the first modality image data set and a second modality image data set in the selected motion state.

21. (Rejected) The method as claimed in claim 19, wherein the first imaging modality data acquisition system includes one of a positron emission tomography (PET) system and a single positron emission computed tomography (SPECT) system.

22. (Rejected) The method as claimed in claim 19, wherein the second imaging modality data acquisition system includes a computer tomography (CT) system, an ultrasound system, or a fast magnetic resonance (MR) tomography system.

23. (Rejected) The method as claimed in claim 19, further including:

registering coordinates systems of the first and second imaging modality data acquisition systems.

24. (Cancelled)

25. (Rejected) The method as claimed in claim 19, further including:

sensing motion of the object at least during acquisition of the second sequence of imaging data.

26. (Rejected) The method as claimed in claim 25, wherein the sensed motion is a cyclic motion in which the object cyclically assumes each of a plurality of motion states.

27. (Rejected) The method as claimed in claim 19, wherein the motion model includes a motion vector field which indicates movement between at least two motion states.

28. (Rejected) An imaging system comprising:

a first imaging modality data acquisition system for generating a first imaging modality sequence of image data;

a second imaging modality data acquisition system for generating a second imaging modality sequence of image data;

a motion sensor for sensing object motion;

a processor for determining a motion model from the sensed motion and the second modality sequence of image data.

29. (Rejected) The imaging system as claimed in claim 28, wherein the motion model characterizes motion states assumed by the object while moving among a plurality of motion states.

30. (Rejected) The imaging system as claimed in claim 28, further including:

operating mathematically with the motion model to transform the first imaging modality image data to a selected motion state.

31. (Rejected) The imaging system as claimed in claim 28, wherein the first imaging modality data acquisition system is a PET system and the second imaging modality data acquisition system is a CT system.

32. (Rejected) A method for motion corrected imaging comprising:

generating image data using a first imaging modality;

generating a plurality of images using a second imaging modality;

from the second imaging modality images and sensed motion of an imaged object, generating a motion model;

operating on the first modality image data with the motion model to create a first modality image in a selected motion state.

33. (Rejected) The method as claimed in claim 32, further including:

combining the first modality image in the selected motion state with a second modality image in the selected motion state.

34. (Rejected) The method as claimed in claim 25, wherein the sensed motion is a periodic motion in which the object periodically assumes each of a plurality of motion states.

APPENDIX (Continued)

XI. CLAIM SUPPORT AND DRAWING ANALYSIS SECTION (41.37(r))

1. A method comprising:

acquiring first modality image data **{P1; PET}** while an imaged object moves over a range of motion and reconstructing **{R1}** the first modality image data into a motion artifacted first modality image **{I0; I5}**; **{p. 8, l. 1-28; p. 10, l. 18-34; Fig. 1-3}**

acquiring- second modality image data and reconstructing **{10; Fig. 6}** the second modality image data into second modality images **{I2; I3; CT}** which represent the object in respective states of motion **{inhaled; exhaled}** with as few motion artifacts as possible; **{p. 8, l. 29 – p. 10, l. 18; Fig. 1, 6; p. 11, l. 11-24; Fig. 1-3}**

from the second modality images **{I2, I3}**, determining **{C1; S1, M1, F1}** a motion model **{M1, M2}** which characterizes states of motion assumed by the object while moving through the states of motion; **{p. 11, l. 25 – p. 13, l. 12; Fig. 1-4}**

forming **{C2}** an intermediate image **{I4}** of the object from the motion model **{M2}** and the second modality images **{I2, I3}**, the intermediate image representing the object as if it had moved during the acquiring of the second modality **{CT}** image data over the range of

motion over which the object moved as the first modality imaging data was acquired; **{p. 13, l. 13-23; Fig. 1, 3}**

forming **{R3}** a combination image **{I6, I9}** from the intermediate image **{I4}** and the first modality image **{I0; I5}**. **{p. 13, l. 24 – p. 15, l. 29; Fig. 1, 2}**

2. A method of enhancing a first image **{I0; I5}** of a moving object, the first image containing motion artifacts, the method including:

a. acquiring further images **{I2, I3}** that represent the object in respective states of motion with as few motion artifacts as possible; **{p. 8, l. 29 – p. 10, l. 18; Fig. 1, 6; p. 11, l. 11-24; Fig. 1-3}**

b. from the further images **{I2, I3}**, determining a motion model that characterizes the states of motion assumed by the object; **{p. 11, l. 25 – p. 13, l. 12; Fig. 1-4}**

c. focusing **{B2 }** the first image **{I0}** by means of the motion model **{M2}**. **{p. 16, l. 9-23; Fig. 2}**

3. A method of enhancing information contents of a first image **{I0}** of a moving object, to be reconstructed from projections **{P1}** acquired as the object moves over a plurality of states of motion and containing motion artifacts **{10; Fig. 6}**, which method includes:

a. acquiring further images **{I2, I3}** that represent the object in at least two of the states of motion with as few motion artifacts as possible; **{p. 8, l. 29 – p. 10, l. 18; Fig. 1, 6; p. 11, l. 11-24; Fig. 1-3}**

b. from the further images **{I2, I3}**, determining **{C1; S1, M1, F1}** a motion model **{M2}** that characterizes the states of motion assumed by the object while the projections **{P1}** are acquired; **{p. 11, l. 25 – p. 13, l. 12; Fig. 1-4}**

c. forming **{C2}** at least one intermediate image **{I4}** of the object from the motion model **{M2}** and the further images **{I2, I3}**, the at least one intermediate image **{I4}** representing one or more of the states of motion assumed by the object while the projections **{P1}** are acquired; **{p. 13, l. 13-23; Fig. 1, 3}**

d. reconstructing **{R5}** the first image **{I10}** from the projections **{P1}** of the object and the at least one intermediate image **{I4}**. **{p. 16, l. 24 – p. 17, l. 15}**

4. The method as claimed in claim 1, wherein determining **{C1}** the motion model **{M2}** includes:

determining a respective motion vector field **{$\vec{m}$ ($\vec{x}_3$)}** for parts of the object. **{p. 12, l. 23 – p. 13, l. 12; Figs. 1-4}**

5. The method as claimed in claim 1, wherein forming the intermediate image **{I4}** includes:

forming **{C2}** other images **{I2, I3}** of other states of motion of the object from the second modality image data; **{p. 13, l. 13-16; Fig. 1-3}**

weighting and subsequently superimposing the other images and the second modality images in conformity with a frequency **{f(x)}** at which each of the other states of motion were assumed by the object while moving over the range of motion while the first modality image data was acquired. **{p. 13, l. 13-23; Fig. 1-4}**

6. The method as claimed in claim 1, further including:

elastically registering **{R2}** the intermediate image and the first modality image prior to the formation of the combination image. **{p. 14, l. 6 – p. 15, l. 24; Fig. 1}**

7. The method as claimed in claim 1, further including:

focusing **{B1}** the combination image **{I6}**. **{p. 15, l. 30 – p. 16, l. 4; Fig. 1}**

8. The method as claimed in claim 2, further including:

registering {**R2, R4**} the focused image {**I8**} and at least one of the further images {**I2**}; {**p. 16, l. 5-8, Fig. 1; Fig. 2**} and

forming a combination image {**I9**} from the focused first image {**I8**}and the at least one of the further images {**I2**}. {**p. 16, l. 9-23; Fig. 1, 2**}

9. The method as claimed in claim 1, wherein the first modality image {**I0**} is one of a positron emission tomography (PET) image or a single positron emission computed tomography (SPECT) image and the second modality images {**I2, I3**} are one of computed tomography (CT) images and magnetic resonance (MR) images. {**p. 7, l. 29-34; p. 20, l. 29-31**}

10. An image processing system {**7, 10, 22, 23**} which includes a data processing unit for carrying out the method as claimed in claim 1. {**p. 9, l. 9 – p. 11, l. 8; Fig. 6**}

11. A medical examination apparatus, the apparatus {**Fig. 6**} including:

a device {**22**} for forming images {**I0**} or projections {**P1**} by means of a first imaging method; {**p. 10, l. 18-27; Fig. 6**}

a second device **{10}** for forming images **{I2, I3}** or projections by means of a second imaging method; **{p. 10, l. 12-17; Fig. 6}**

an image processing system **{23}** that includes a data processing unit for carrying out the method as claimed in claim 1. **{p. 11, l. 1-8; Fig. 6}**

12. A computer readable medium containing instructions for controlling a data processing unit in such a manner that the data processing unit can carry out the method as claimed in claim 1. **{p. 21, l. 14-16}**

13. The method as claimed in claim 2, wherein determining the motion model **{M2}** includes:

determining a respective motion vector field **{$\vec{m}$ ($\vec{x_3}$)}** for parts of the object. **{p. 2, l. 23 – p. 13, l. 12; Fig. 1-4}**

14. The method as claimed in claim 3, wherein determining the motion model includes:

determining a respective motion vector field **{$\vec{m}$ ($\vec{x_3}$)}** for parts of the object. **{[p. 12. ;l. 23 – p. 13. l. 12; Figs. 1-4}**

15. The method as claimed in claim 2, further including:

forming additional images **{I2, I3}** of others of the states of motion of the object from the further images and the motion model {**M2**}; **{p. 13, l. 13-16; Figs. 1-3}**

weighting and subsequently superimposing **{R3, R4}** the other images and the second modality images in conformity with a frequency **{f(x)}** at which each of the other states of motion were assumed by the object while moving over the range of motion over which the first modality image data was acquired. **{p. 13, l. 13-23; Fig. 1-4}**

16. The method as claimed in claim 3, further including:

forming additional images of others of the states of motion of the object from the further images and the motion model {**M2**}; **{p. 13, l. 13-16; Figs. 1-3}**

weighting and subsequently superimposing the other images and the second modality images **{I2, I3}** in conformity with a frequency at which each of the other states of motion were assumed by the object while moving over the range of motion at which the first modality image data was acquired. **{p. 13, l. 13-29; Figs. 1-4}**

17. The method as claimed in claim 2 wherein the first image **{I0}** is a positron emission tomography (PET) image or a single positron emission computed tomography (SPECT) image and the further images

are one of computed tomography (CT) images and magnetic resonance (MR) images. **{p. 7, l. 29-34; p. 17, l. 22-26; p. 20, l. 29-31}**

18. The method as claimed in claim 3 wherein the first image **{I0}** is a positron emission tomography (PET) image or a single positron emission computed tomography (SPECT) image and the further images are one of computed tomography (CT) images and magnetic resonance (MR) images. **{p. 7, l. 29-34; p. 17, l. 22-26; p. 20, l. 29-31}**

19. A method of motion compensation comprising:

acquiring a first sequence of image data **{P1}** of a moving object by a first imaging modality data acquisition system **{20, 22}**; **{p. 8, l. 1-28; p. 10, l. 18-34; Figs. 1-3, 6}**

acquiring a second sequence of image data **{I5}** of the moving object by a second imaging modality data acquisition system **{1-5, 16}**; **{p. 8, l. 29 – p. 10, l. 18; Figs. 1-3, 6}**

determining a motion model **{M1}** related to periodic motion of the object based on the second sequence of image data; **{p. 12, l. 12-22}**

using the determined motion model **{M1}**, generating from the first sequence of image data **{I5}** a first modality image data set **{I2, I3}** in a selected motion state. **{p. 11, l. 25 – p. 13, l. 12; Fig. 1-4}**

20. The method as claimed in claim 19, further including:

generating a combined image data set **{I6, I9}** in the selected motion state from the first modality image data set **{P1}** and a second modality image data set **{I5}** in the selected motion state. **{p. 16, l. 5 – p. 16, l. 23}**

21. The method as claimed in claim 19, wherein the first imaging modality data acquisition system includes one of a positron emission tomography (PET) system and a single positron emission computed tomography (SPECT) system. **{p. 7, l. 29-34; p. 17, l. 22-26; p. 20, l. 29-31}**

22. The method as claimed in claim 19, wherein the second imaging modality data acquisition system includes a computer tomography (CT) system, an ultrasound system, or a fast magnetic resonance (MR) tomography system. **{p. 7, l. 29-34; p. 17, l. 22-26; p. 20, l. 29-31}**

23. The method as claimed in claim 19, further including:

registering **{R2}** coordinates systems of the first and second imaging modality data acquisition systems. **{p. 14, l. 6 – p. 15, l. 24; Figs. 1-3}**

24. (Cancelled)

25. The method as claimed in claim 19, further including:

sensing motion of the object at least during acquisition of the second sequence of imaging data. **{p. 10, l. 8-17; p. 11, l. 25 – p. 12, l. 22; Fig. 6}**

26. The method as claimed in claim 25, wherein the sensed motion is a cyclic motion in which the object cyclically assumes each of a plurality of motion states. **{p. 11, l. 11 – p. 12, l. 22}**

27. The method as claimed in claim 19, wherein the motion model includes a motion vector field **{$\vec{m}'(\vec{x_3})$}** which indicates movement between at least two motion states. **{p. 12, l. 23 – p. 13, l. 12}**

28. An imaging system comprising:

a first imaging modality data acquisition system **{20-22}** for generating a first imaging modality sequence of image data; **{p. 10, l. 18-27; Fig. 6}**

a second imaging modality data acquisition system **{1-5, 10}** for generating a second imaging modality sequence of image data; **{p. 9, l. 9 – p. 10, l. 17; Fig. 6}**

a motion sensor **{S1, 15}** for sensing object motion; **{p. 10, l. 12-17; Fig. 6}**

a processor **{12}** for determining a motion model **{M1, M2}** from the sensed motion and the second modality sequence of image data **{I5}**. **{p. 10, l. 12-17; p. 12, l. 12-22; Fig. 6}**

29. The imaging system as claimed in claim 28, wherein the motion model characterizes motion states assumed by the object while moving among a plurality of motion states. **{p. 12, l. 12 – p. 14, l. 5}**

30. The imaging system as claimed in claim 28, further including:

operating mathematically with the motion model to transform the first imaging modality image data to a selected motion state. **{p. 11, l. 11 – p. 12, l. 22}**

31. The imaging system as claimed in claim 28, wherein the first imaging modality data acquisition system is a PET system and the second

imaging modality data acquisition system is a CT system. **{p. 7, l. 29-34; p. 8, l. 1-16; p. 8, l. 29 – p. 9, l. 8}**

32. A method for motion corrected imaging comprising:

generating image data {**P1**} using a first imaging modality {**PET**}; **{p. 8, l. 1-28; p. 10, l. 18-27; Fig. 1-3, 6}**

generating a plurality of images {**I2, I3**} using a second imaging modality {**CT**}; **p. 8, l. 29 – p. 10, l. 17; Fig. 1-3, 6}**

from the second imaging modality images {**I2, I3**} and sensed motion of an imaged object, generating a motion model {**M1, M2**}; **{p. 11, l. 25 – p. 13, l. 12; Figs. 1-3}**

operating {**B1, B2**} on the first modality image data {**P1, I0**} with the motion model to create a first modality image {**I7, I8**} in a selected motion state. **{p. 15, l. 30 – p. 16, l. 23}**

33. The method as claimed in claim 32, further including:

combining {**R4**} the first modality image {**I8**} in the selected motion state with a second modality image {**I2**} in the selected motion state.

34. The method as claimed in claim 25, wherein the sensed motion is a periodic motion in which the object periodically assumes each of a plurality of motion states. **{p. 11, l. 11 – p. 13, l. 23}**

APPENDIX (Continued)

XII. MEANS OR STEP PLUS FUNCTION ANALYSIS SECTION (41.37(s))

Not applicable

APPENDIX (Continued)

XIII. **EVIDENCE SECTION (41.37(t))**

Not applicable

APPENDIX (Continued)

XIV. RELATED CASES SECTION (41.37(u))

None